
Summary of HCAT Helicopter Dynamic Components Project

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- Hazmat**
Alternatives

Team

- ❑ Bruce Sartwell – PI
- ❑ Fleet Readiness Center – East (Cherry Point)
 - Robert Kestler
- ❑ Bell Helicopter – Gearbox component rig tests
 - Greg Haataja
- ❑ UTRC – Fretting fatigue
 - Aaron Nardi
- ❑ Sikorsky
 - Bob Guillemette, Bob Luchenta
- ❑ Hitemco – HVOF deposition
 - Ed Garofolo

Joint Test Protocol

- ❑ Materials
 - Alloys – 4340 160ksi, PH13-8Mo H1050, 9310 carburized, 7075 T73 Al
 - Coatings – EHC, WC-Co, WC-CoCr, T400, T400+WC-Co (Al only)
- ❑ Fatigue (smooth bar), $R=0.1$
- ❑ Fretting fatigue (WC-Co and EHC only)
- ❑ G85 SO_2 salt fog
- ❑ Gearbox component bench testing (Bell)
- ❑ Endurance testing gearbox components (FRC-E)
- ❑ Lead-the-fleet testing (FRC-E)

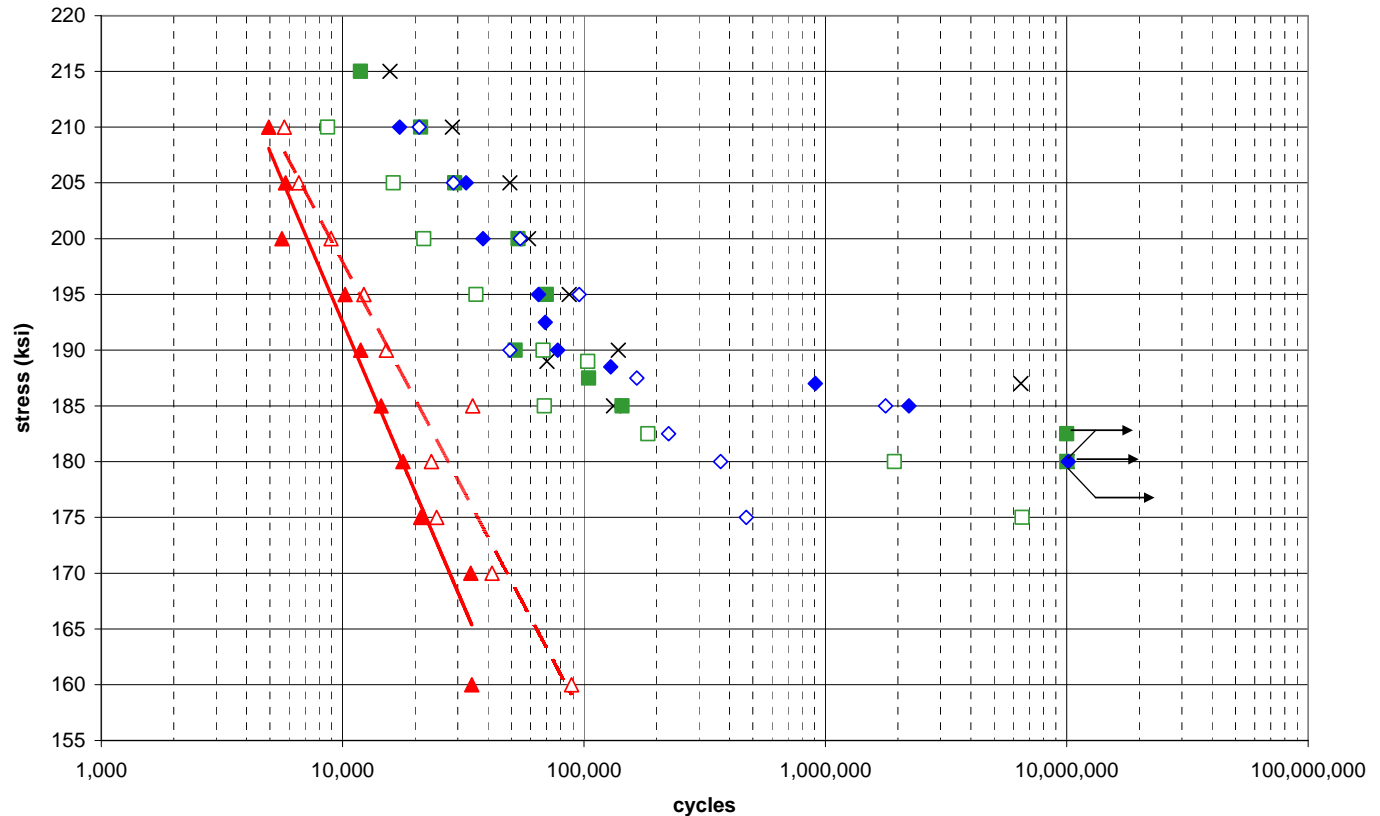
Fatigue

Usually thicker coatings give more fatigue

Here thicker is better

Presumably carrying load

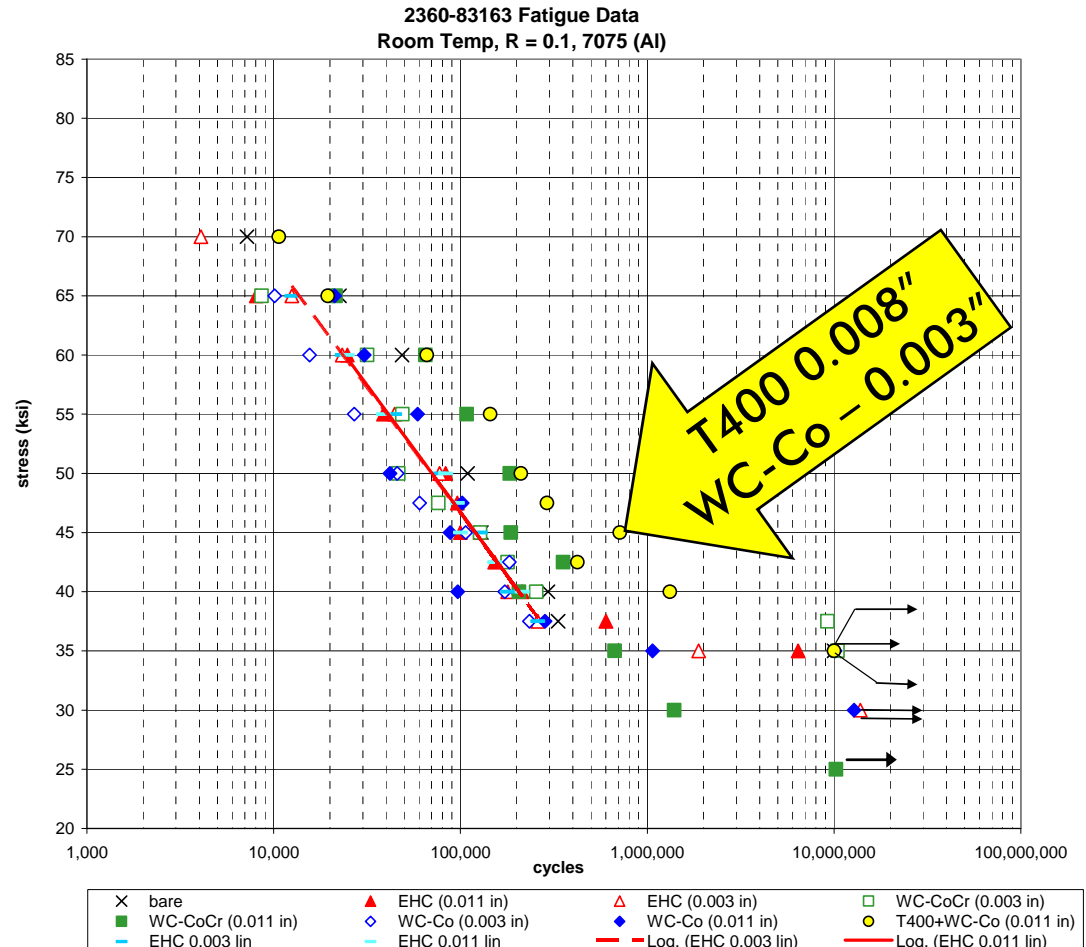
2360-83163 Fatigue Data
Room Temp, R = 0.1, 9310 (steel)



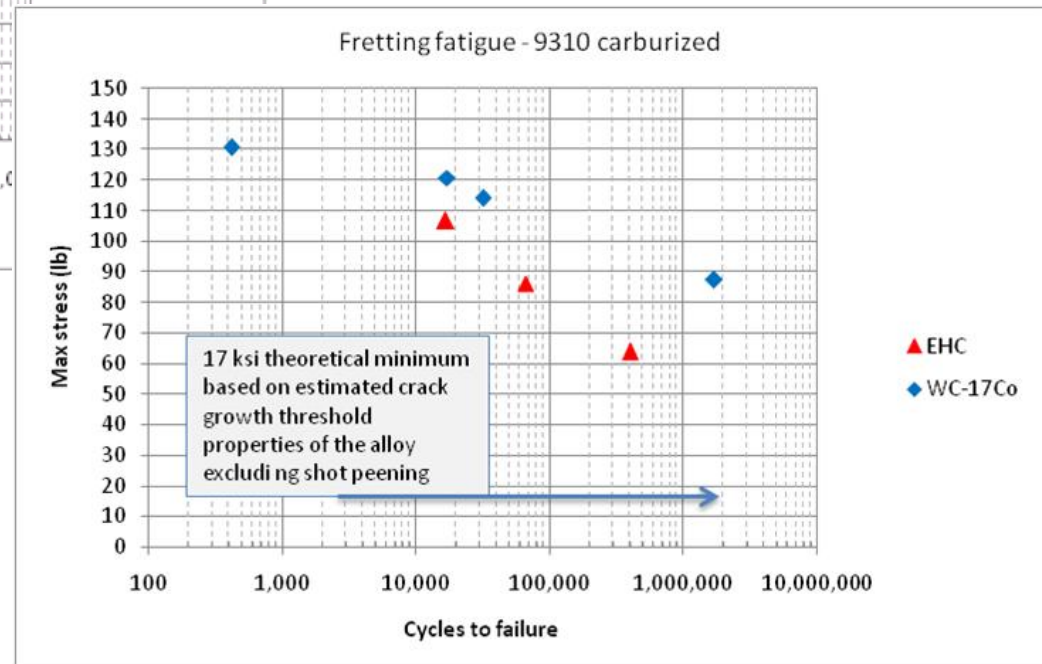
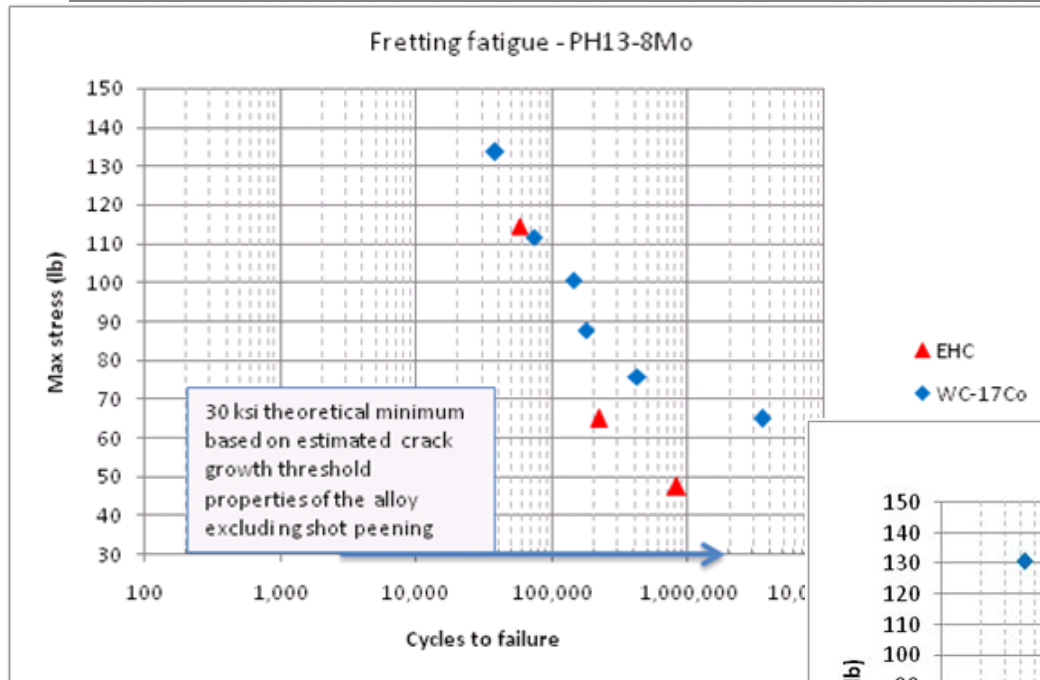
Fatigue of 7075 Al

In the past HVOF carbides gave fatigue worse than EHC

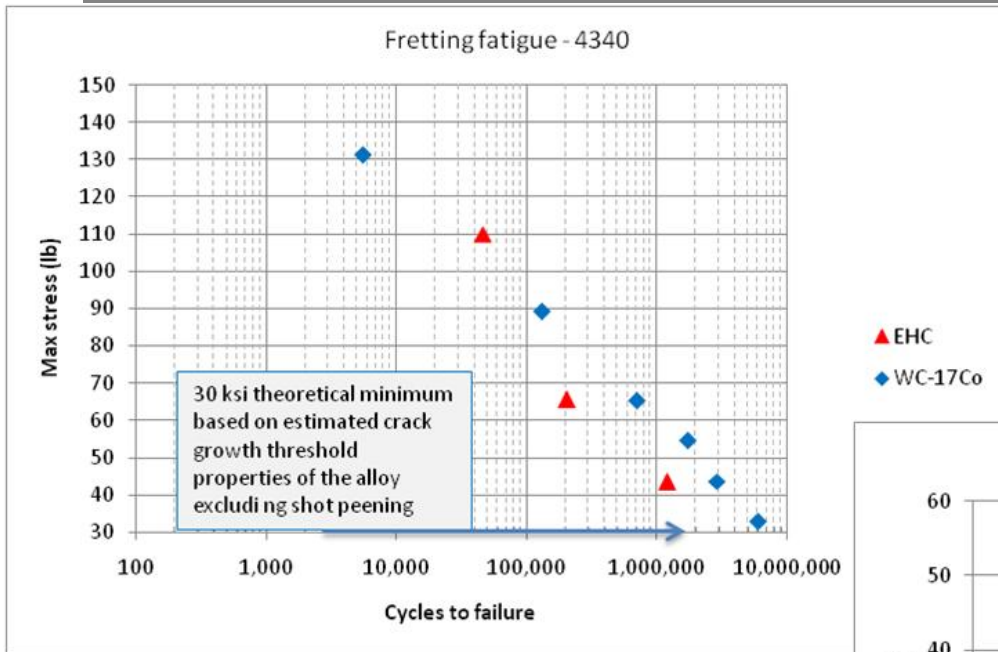
Here WC-CoCr is better and duplex coating is a lot better
Better modulus match



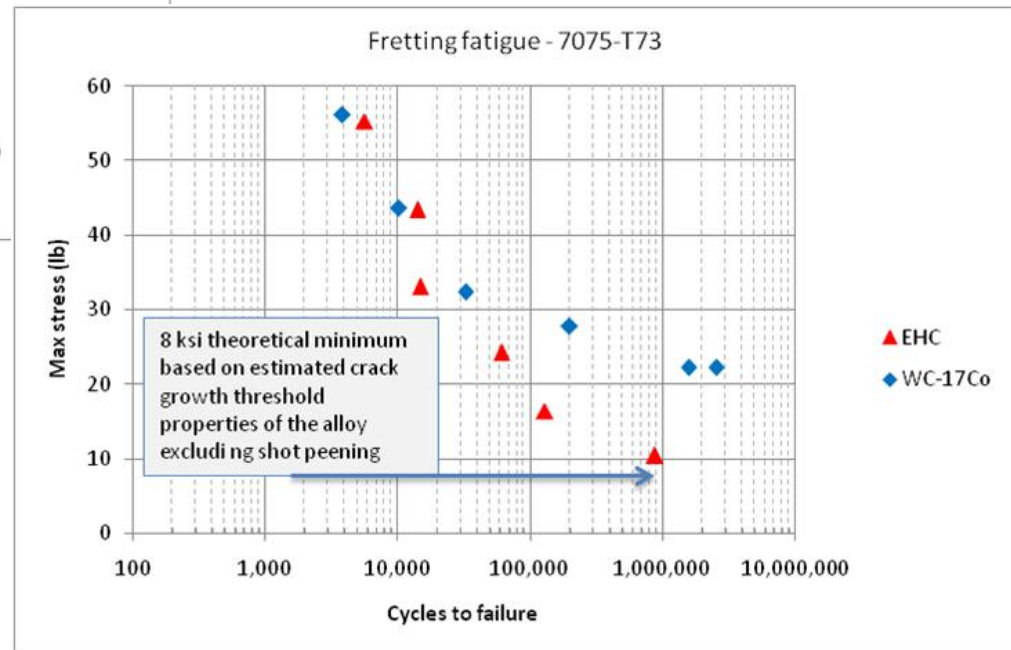
Fretting fatigue – 0.011" WC-Co



Fretting fatigue



In all cases HVOF WC-Co better than EHC
 Better wear, so slower to damage and initiate cracks



G85 – 9310 carburized

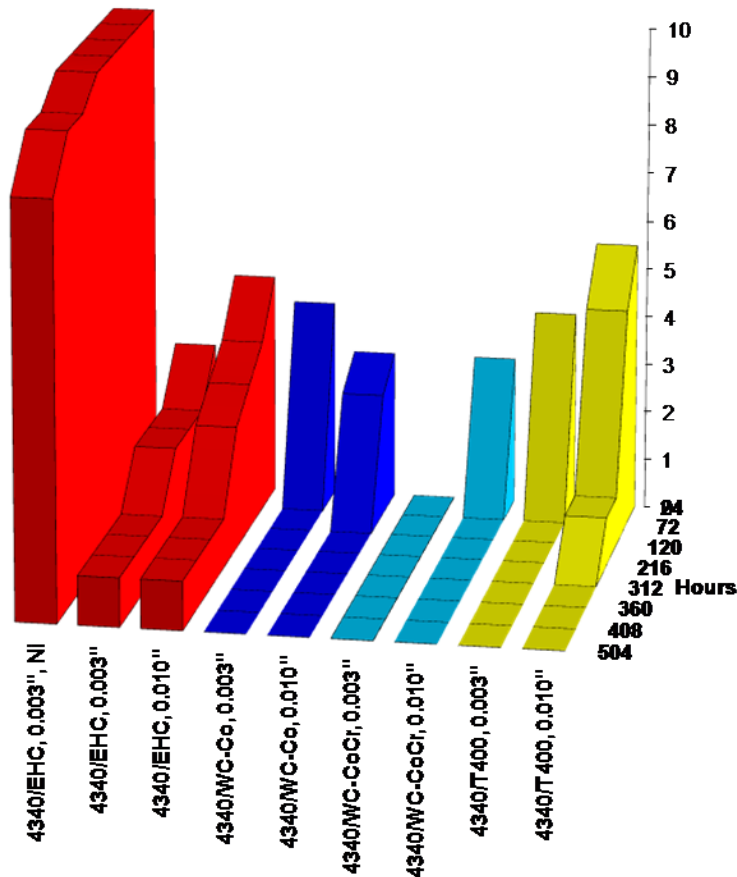
Matrix of specimen photos vs time shows when specimens taken out of chamber on Rank=1

Only EHC lasted the full 500hr

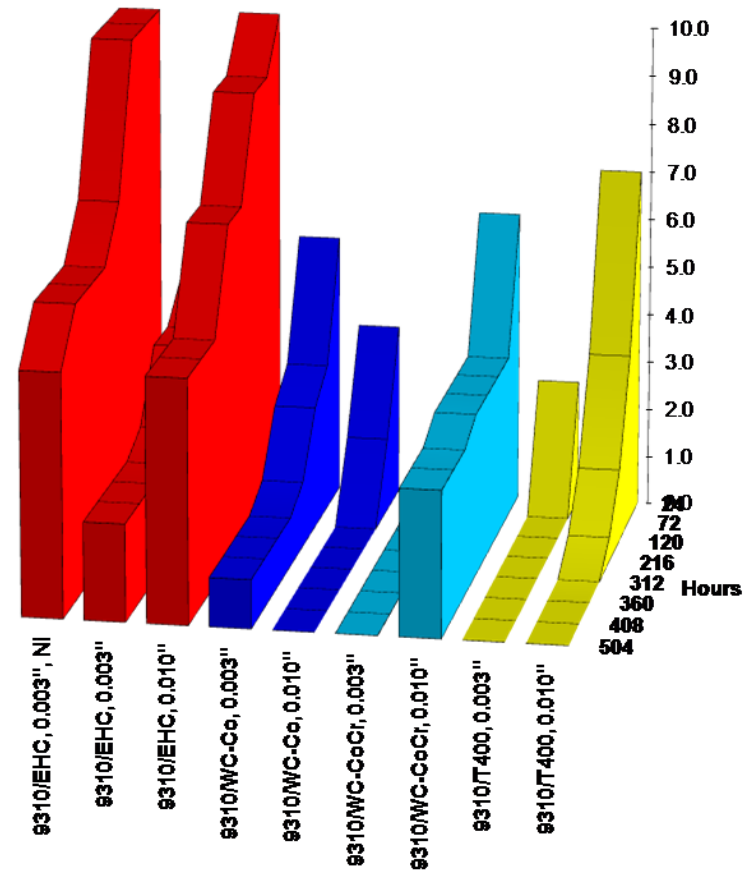
Coating	Thickness	Ni Sublayer	0	24	72	120	216	312	360	408	504	Abraded
EHC	3	Yes										
EHC	3	Yes										
EHC	3	No										
EHC	3	No										
EHC	3	No										
EHC	10	No										
Tribaloy 400	3	No										
Tribaloy 400	3	No										
Tribaloy 400	10	No										
Tribaloy 400	10	No										
WC-Co	3	No										
WC-Co	3	No										
WC-Co	10	No										
WC-Co	10	No										
WC-CoCr	3	No										
WC-CoCr	3	No										
WC-CoCr	10	No										
WC-CoCr	10	No										

Appearance rank – after clean at end of test

4340 Appearance number



9310 Appearance number



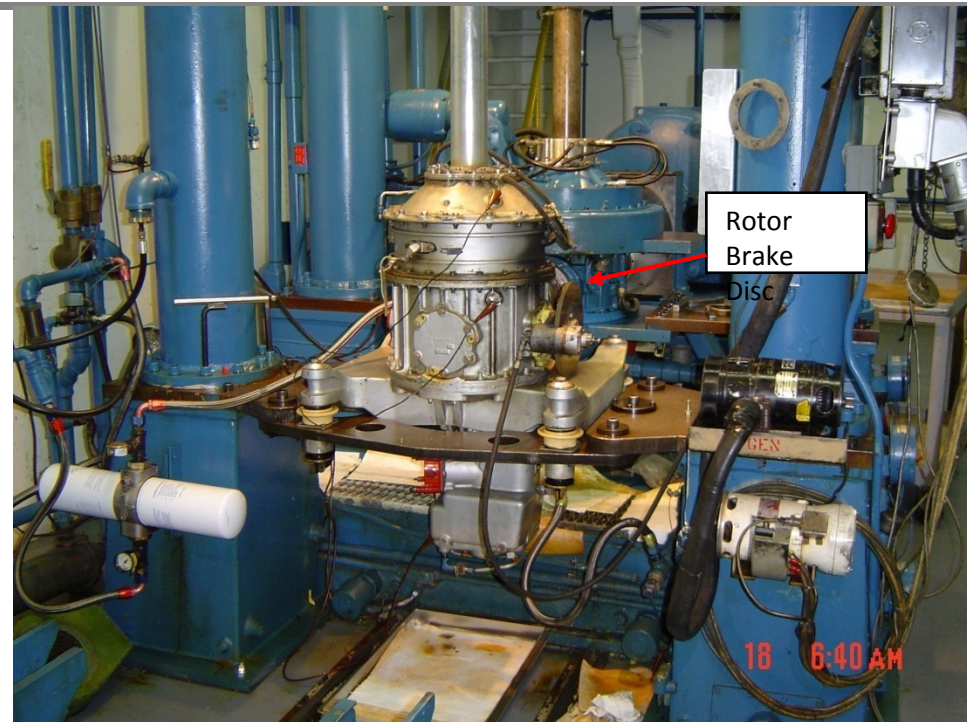
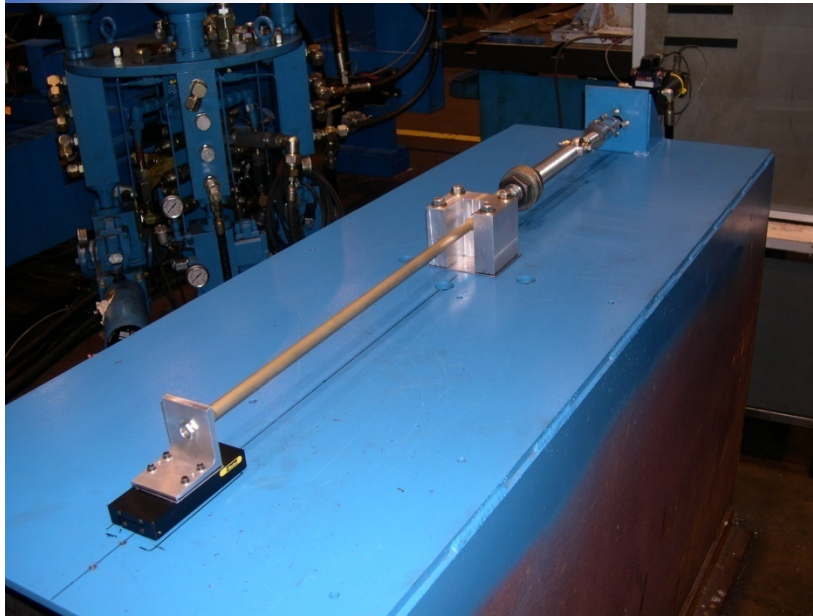
What does corrosion data mean?

□ Probably nothing

- Well-established that B117 salt fog tests have negative correlation with performance of HVOF vs EHC
- Service corrosion performance of HVOF usually much better than EHC
- G85 likely to be similar
 - Will not know for sure until shipboard exposure service test data are available

Bell Helicopter rig tests – WC-Co vs EHC

Tail Rotor Control Rod
Test included AZ road dust

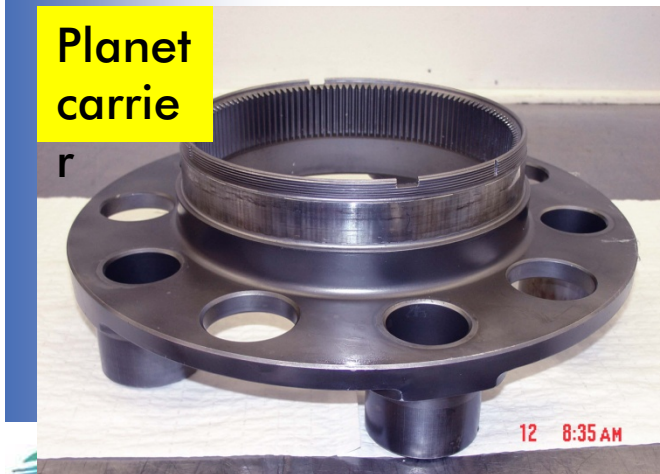
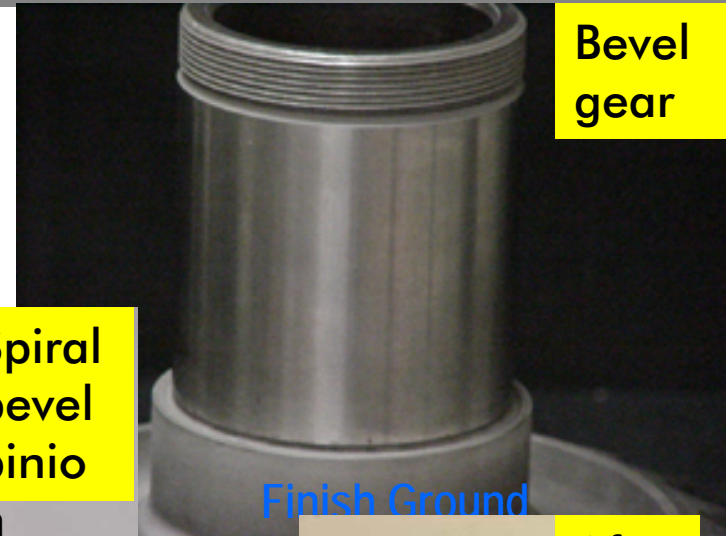
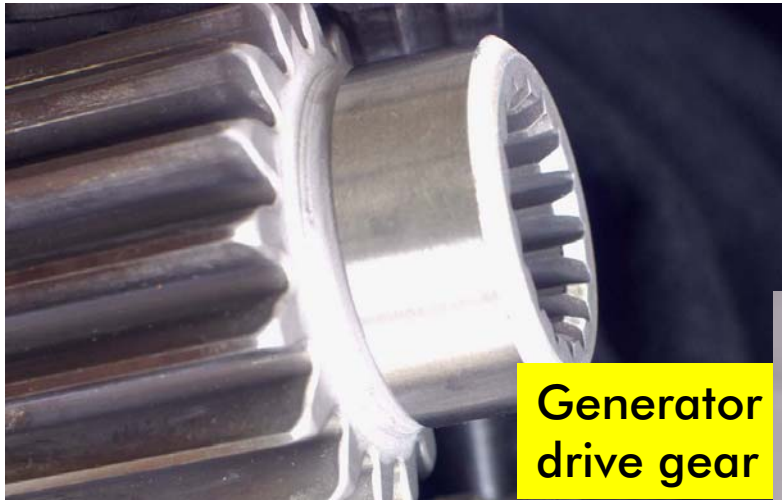


Rotor Brake Disc Adapter Flange

Components qualified by tests

Flange, adapter rotor brake disc	UH-1
Flange, adapter rotor brake disc	AH-1
Spacer, tail rotor drive quill	UH-1, AH-1
Spacer, tail rotor drive quill	UH-1
Sleeve, Collective Scissors and Sleeve, Main Rotor Controls	UH-1H
No wear or leakage – performance of HVOF same as EHC or better	

H46 components validation at FRC-E



Lead-The-Fleet testing at FRC-E

Problem:

- MRH Damper Current MTBR ~ 600 FH.

Cause:

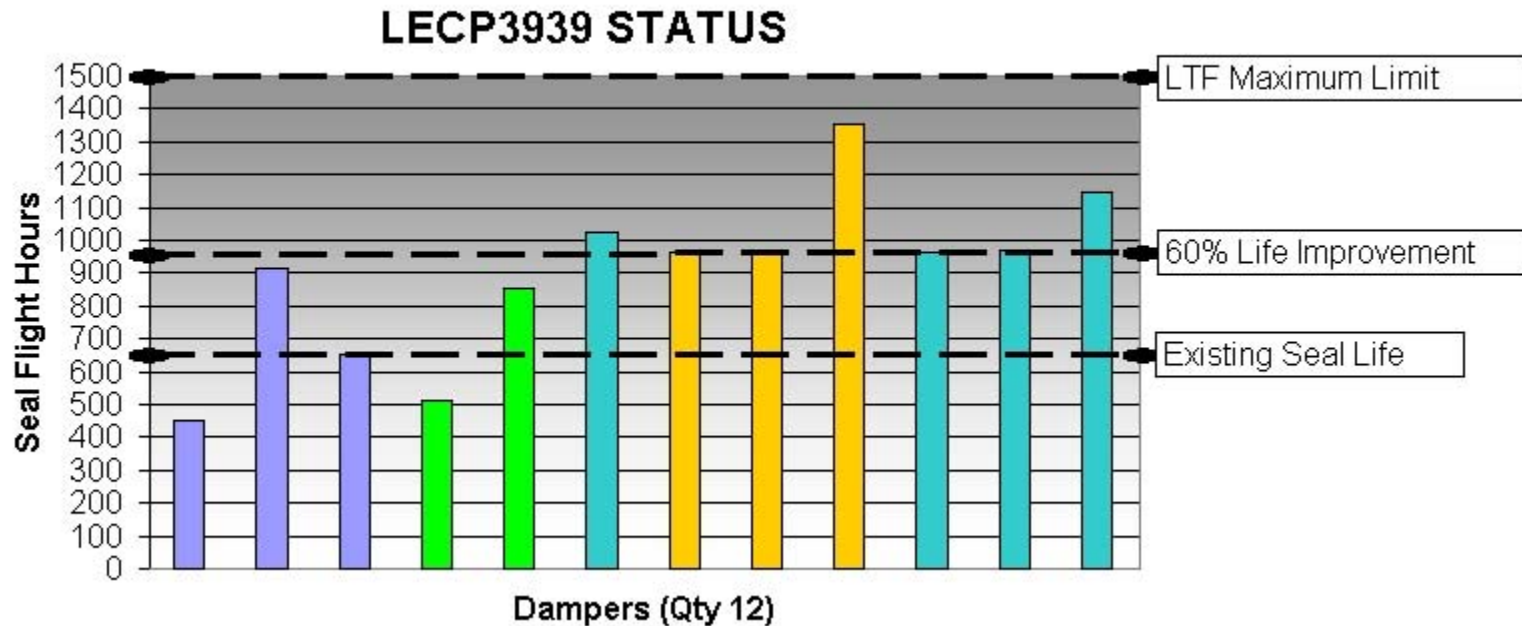
- Premature dynamic seal failure
- Caused by destructive wear particles from the Beryllium Copper bushing

Corrective Action:

- Improved seal designs, new coatings, stainless steel bushing coated in Katherm-87.
- Lead-the-Fleet Evaluation began FEB 2004.



Current status



Status as of Jan 07

